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# UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 C.F.R. § 1.53(b))

Attorney Docket No. 196-1203

First Inventor or Application Identifier Matzen

Title Method For Testing an Electromagnetic Flowmeter, and an Electromagnetic...

Express Mail Label No. EL 388 803 056 US

## APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

1. ☒ \* Fee Transmittal Form (e.g., PTO/SB/17)  
(Submit an original and a duplicate for fee processing)
2. ☒ Specification [Total Pages 13]  
(preferred arrangement set forth below)
  - Descriptive title of the Invention
  - Cross References to Related Applications
  - Statement Regarding Fed sponsored R & D
  - Reference to Microfiche Appendix
  - Background of the Invention
  - Brief Summary of the Invention
  - Brief Description of the Drawings (if filed)
  - Detailed Description
  - Claim(s)
  - Abstract of the Disclosure
3. ☒ Drawing(s) (35 U.S.C. 113) [Total Sheets 3]
4. Oath or Declaration [Total Pages 3]
  - a. ☒ Newly executed (original or copy)
  - b. ☐ Copy from a prior application (37 C.F.R. § 1.63(d))  
(for continuation/divisional with Box 16 completed)
    - i. ☐ DELETION OF INVENTOR(S)  
Signed statement attached deleting inventor(s) named in the prior application, see 37 C.F.R. §§ 1.63(d)(2) and 1.33(b).

\* NOTE FOR ITEMS 1 & 13: IN ORDER TO BE ENTITLED TO PAY SMALL ENTITY FEES, A SMALL ENTITY STATEMENT IS REQUIRED (37 C.F.R. § 1.27), EXCEPT IF ONE FILED IN A PRIOR APPLICATION IS RELIED UPON (37 C.F.R. § 1.28).

ADDRESS TO: Assistant Commissioner for Patents  
Box Patent Application  
Washington, DC 20231

5. ☐ Microfiche Computer Program (Appendix)
6. Nucleotide and/or Amino Acid Sequence Submission (if applicable, all necessary)
  - a. ☐ Computer Readable Copy
  - b. ☐ Paper Copy (identical to computer copy)
  - c. ☐ Statement verifying identity of above copies

## ACCOMPANYING APPLICATION PARTS

7. ☒ Assignment Papers (cover sheet & document(s))
8. ☐ 37 C.F.R. § 3.73(b) Statement of Power of Attorney (when there is an assignee)
9. ☐ English Translation Document (if applicable)
10. ☐ Information Disclosure Statement (IDS)/PTO-1449
11. ☒ Preliminary Amendment
12. ☒ Return Receipt Postcard (MPEP 503) (Should be specifically itemized)
13. ☐ \* Small Entity Statement(s) filed in prior application, Status still proper and desired (PTO/SB/09-12)
14. ☒ Certified Copy of Priority Document(s) (if foreign priority is claimed)
15. ☐ Other:

16. If a CONTINUING APPLICATION, check appropriate box, and supply the requisite information below and in a preliminary amendment:  
☐ Continuation ☐ Divisional ☐ Continuation-in-part (CIP) of prior application No: \_\_\_\_\_  
 Prior application information: Examiner \_\_\_\_\_ Group / Art Unit: \_\_\_\_\_  
 For CONTINUATION or DIVISIONAL APPS only: The entire disclosure of the prior application, from which an oath or declaration is supplied under Box 4b, is considered a part of the disclosure of the accompanying continuation or divisional application and is hereby incorporated by reference. The incorporation can only be relied upon when a portion has been inadvertently omitted from the submitted application parts.

## 17. CORRESPONDENCE ADDRESS

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enclosed:

Steen M. Matzen

**Method For Testing an Electromagnetic Flowmeter, and  
an Electromagnetic Flowmeter Arrangement**

SERIAL NO: To be assigned

FILING DATE: Herewith

1. Utility Patent Application Transmittal
2. Fee Transmittal for FY 1999 in duplicate
3. Check No. 39437 for \$730.00
4. Amendment Accompanying Application
5. Claim for Priority
6. Certified Copy of German Registration
7. Assignment Transmittal and Assignment
8. Declaration and Power of Attorney
9. Specification with one (3) sheets of drawings
10. Certificate of EXPRESS MAIL.
11. Return Post Card.

DATE SENT: April 12, 2000  
WJR:lmb

"Express Mail" mailing label number

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Date of deposit: April 12, 2000

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**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

IN RE THE APPLICATION OF )  
)  
Steen M. Matzen )  
)  
SERIAL NO.: To be Assigned )  
)  
FILED: Herewith )  
)  
FOR: Method for Testing an Electromagnetic )  
Flowmeter, and an Electromagnetic )  
Flowmeter Arrangement )

**AMENDMENT ACCOMPANYING APPLICATION**

Honorable Commissioner of  
Patents and Trademarks  
Washington, D.C. 20231

Dear Sir:

Before calculation of the filing fee for the present application, it is requested that the application be amended as follows:

**In the Specification**

Page 1, after the title, add the heading - - Background of the Invention - -

Page 2, before the first line, add the heading - - Summary of the Invention - -

Page 5, after numbered line 23, add the heading - - Brief Description of the Drawings - -

Page 6, after numbered line 1, add the heading - - Description of the Preferred Embodiments - -

**In the Claims**

Cancel claims 1 through 17 without prejudice, and substitute new claims 18 through 35 as follows:

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18. A method for testing an electromagnetic flowmeter having a measuring tube and a coil arrangement for generating a magnetic field perpendicular to the direction of flow through the measuring tube, the current direction in the coil arrangement being periodically changed, comprising the steps of sensing the change in the current direction, and after the change in the current direction determining at least one parameter of the current rise and comparing the parameter with a reference value.

19. A method according to claim 18, in which testing is carried out during measurement of a throughflow.

20. A method according to claim 18, in which the reference value is determined from the flowmeter at an earlier time.

21. A method according to claims 18, in which a time period that elapses between two predetermined current values is used as the parameter.

22. A method according to claims 18, in which a time period that elapses between change in the current direction and reaching a predetermined current value is used as the parameter.

23. A method according to claim 18, in which after change in the current direction, a stepped-up voltage is used.

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24. A method according to claims 18, in which the supply voltage of the coil arrangement is regulated ratiometrically in relation to a reference voltage which is also used to determine the parameter.

25. A method according to claim 18, in which the curve shape of the current rise is used as the parameter.

26. A method according to claim 25, in which the curve shape is formed by current values ascertained at predetermined times.

27. A method according to claim 18, in which current rises following directly one after the other are compared with one another.

28. An electromagnetic flowmeter arrangement having a measuring tube, a coil arrangement for generating a magnetic field substantially perpendicular to the direction of flow through the measuring tube, an electrode arrangement substantially perpendicular to the direction of flow and to the magnetic field, a supply system for the coil arrangement which has a current direction change-over arrangement, and a testing device, the testing device including means which, after a change-over of the current direction, determines at least one parameter of the rise in the current in the coil arrangement and compares the parameter with a given value.

29. An arrangement according to claim 28, in which the testing device comprises a time-counter and a rise time serves as the parameter.

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30. An arrangement according to claim 29, in which the testing device further comprises a comparator which compares the current or a variable derived therefrom with a given value and which is connected to the time-counter.

31. An arrangement according to claim 29, in which the time-counter is connected to a checking unit which produces an error message whenever the time ascertained differs by more than a predetermined difference from a given value.

32. An arrangement according to claim 30, in which the time-counter is connected to a checking unit which produces an error message whenever the time ascertained differs by more than a predetermined difference from a given value.

33. An arrangement according to claim 28, in which an electrical resistance is arranged in series with the coil arrangement, the resistance having a temperature-dependent resistance behavior which is inversely proportional to that of the coil arrangement.

34. An arrangement according to claim 28, including a supplementary voltage supply system connected to the supply system by means of a change-over switch.

35. An arrangement according to claim 28, comprising an analogue-to-digital converter, which determines the analogue values in relation to a reference voltage, the value of which is also used as a starting point for determining coil current and coil supply voltage.

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Remarks

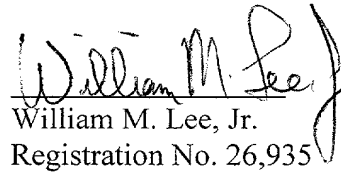
The above amendments are being made in order to add appropriate headings to the specification, as well as replace claims 1 through 17, which are simply literal translations, with new claims 18 through 35 that are in proper form in accordance with U.S. practice and eliminate improper multiple dependency.

Claims 18 through 35 correspond, respectively, to cancel claims 1 through 17, except that former claim 14 has been replaced by new claims 31 and 32, with different dependencies. Other than that, there is a one-to-one correspondence between the canceled claims and the new claims.

Examination of the application on its merits is awaited.

April 12, 2000

Respectfully submitted,

  
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Method for testing an electromagnetic flowmeter,  
and an electromagnetic flowmeter arrangement

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The invention relates to a method for testing an electromagnetic flowmeter having a measuring tube and a coil arrangement for generating a magnetic field perpendicular to the direction of flow through the measuring tube, the current direction in the coil arrangement being periodically changed. The invention also  
5 relates to an electromagnetic flowmeter arrangement having a measuring tube, a coil arrangement for generating a magnetic field substantially perpendicular to the direction of flow through the measuring tube, an electrode arrangement substantially perpendicular to the direction of flow and to the magnetic field, a supply system for the coil arrangement, which has a current direction reversal  
10 arrangement, and a testing device.

A method and a flowmeter arrangement of that kind are known from GB 2 309 308 A. Here, testing is carried out by interrupting the normal connection between the measuring tube, that is, the electrode arrangement, and the coil arrangement, and by linking up an external measuring loop. During testing, a  
15 normal measurement is not therefore possible. There is also the danger that the interruption of the circuit and the subsequent connection will again cause errors that will not be identified. Testing is effected in that the ohmic resistance of the coil arrangement is determined by applying a voltage to the coil. As soon as the ohmic resistance is known, the voltage is interrupted and the inductance of the coil  
20 arrangement is determined by monitoring the decay of the current.

US 5 639 970 describes a current selecting circuit for an electromagnetic flowmeter. This circuit is able to select the correct current and the correct frequency in dependence on the chosen flowmeter. The decision is made by monitoring the response of a coil to energization at relatively high frequency. The faster the signal  
25 response is, the greater can be the current through the coil arrangement.



The invention is based on the problem of enabling the flowmeter to be tested in the simplest possible manner.

That problem is solved in a method of the kind mentioned in the introduction in that after the change in the current direction at least one parameter of the current  
5 rise is determined and this is compared with a reference value.

The coil arrangement forms an inductor. In an inductor, the current cannot "jump". After the direction reversal, it therefore needs a certain time until it is again at its set value. The rise in the current is a kind of "fingerprint" for the corresponding flowmeter. As long as the flowmeter can operate undisturbed, that is, free from  
10 defects, the rise characteristics are practically identical with a very small range of variation range. Only when an electrical or magnetic defect occurs will the rise characteristic change. This is then an indication that the flowmeter is possibly supplying inaccurate measurement results and must be tested or exchanged. This construction has the advantage that both the electrical property and the magnetic  
15 properties are tested, since both electrical and magnetic influences have a characteristic effect on the rise of the current.

Testing is preferably carried out during measurement of a throughflow. Measurement of the throughflow does not even have to be interrupted, yet it is nonetheless possible to carry out testing virtually continuously or permanently. This  
20 has the advantage, moreover, that the flowmeter is tested precisely in the situation in which it is also operative.

In this connection, is it preferred that the reference value is determined at the flowmeter itself at an earlier time. At a specific time, therefore, for example, on commissioning, the desired parameter is established and this is stored as reference  
25 value so that it is available for future testing procedures. Each flowmeter therefore receives an individual reference value, so that testing can be carried out very accurately. Defects that can result from an erroneously pre-set reference value are virtually unknown.

The time period that elapses between two predetermined current values is  
30 preferably used as parameter. Since the rise in the current conforms to a

predetermined physical natural law, as a rule an e-function, it is sufficient to determine the rise time between two values to obtain reliable evidence of the current rise *per se*.

Alternatively, or in addition thereto, in a further preferred construction the  
5 time period that elapses between change-over of the current direction and reaching a predetermined current value can be used as parameter. The time of change-over is identifiable very exactly. For example, the change-over signal can also be used as a trigger signal for a time-counter. The predetermined current value can be, for example, close to the maximum current value, that is, close to the current that exists  
10 in continuous operation. A relatively long period of time is therefore available, so that the testing can produce a correspondingly accurate result.

After change-over, a stepped-up voltage is advantageously used. This voltage, also known as the "boost" voltage, accelerates the build-up of the magnetic field, and consequently enables the actual measurement to be performed more  
15 quickly again. It does also change the current rise, but if the current rise is always carried out in the same manner, that is, with the same increased or "boost" voltage, the characteristic of the current rise can also be used here for testing.

Advantageously, the supply voltage of the coil arrangement is regulated ratiometrically in relation to a reference voltage, which is also used to determine the  
20 parameter. Voltage fluctuations cannot therefore have an adverse effect on the test result. The characteristic of the current rise is then the same, regardless of possible voltage fluctuations, which, of course, if possible, should not occur at all.

As an alternative or in addition to the above-mentioned parameters, the curve shape of the current rise can be used as parameter. This does increase the  
25 complexity of the testing, but allows even more reliable results.

In this connection it is preferred that the curve shape is formed by current values ascertained at predetermined times. These current values can be converted, for example, into digital signals that are evaluated in a microprocessor. The microprocessor can then compare the curve for the measured build-up of the  
30 coil current with one or more reference curves. The entire waveform can therefore

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be monitored. A curve shape varying from the target curve enables one to draw conclusions as to whether there is a variation in the magnetic circuit or in the electric circuitry.

5 Preferably, current rises following directly one after the other are compared with one another. In this way, information as to whether the build-up of the magnetic field is proceeding symmetrically is additionally obtained.

The problem is also solved by an electromagnetic flowmeter arrangement of the kind mentioned in the introduction, in that the testing device comprises means which, after a change-over of the current direction, determine at least one  
10 parameter of the rise in the current in the coil arrangement and compare it with a predetermined value.

As explained above in connection with the method, the rise in the current after change-over of the current direction in the coil arrangement is a significant feature of each flowmeter arrangement. As long as the flow meter arrangement  
15 does not change, this feature also remains unchanged. Variations point to a defect or at least to an inaccuracy. When the rise or a parameter depending thereon is compared with a given value, defects can be identified reliably and above all in good time.

The testing device preferably comprises a time-counter, and a rise time  
20 serves as parameter. Although in this case just a single variable is determined during each current rise, this is sufficiently reliable to allow credible testing or monitoring.

The testing device preferably comprises a comparator, which compares the current or a variable derived therefrom with a given value and which is connected to  
25 the time-counter. The comparator therefore triggers the time-counter whenever the current (or rather a voltage associated therewith) reaches a fixed given value. The time-counter then stops counting and has then, as it were, determined the length of time that the current has needed for its rise.

The time-counter is advantageously connected to a checking unit, which  
30 produces an error message whenever the time ascertained differs by more than a

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predetermined difference from a given value. An exact conformity of the rise time will be reached only in the rarest cases. A small tolerance range is allowed. If, however, the individual times lie outside this tolerance range, a defect is identified.

In series with the coil arrangement there is preferably arranged an electrical  
5 resistance, the temperature-dependent resistance behaviour of which is inversely proportional to that of the coil arrangement. Thermal influences on the coil current can consequently be compensated. The testing can therefore work within a relatively large temperature range with greater accuracy.

Preferably, a supplementary voltage supply system is provided, which is  
10 connected to the supply system by way of a change-over switch. After the change in current direction, first of all the supplementary voltage supply system with a higher voltage is used to build up the coil current. Return to "normal" supply voltage is effected only when the coil current has reached a predetermined value. In that case, change-over to the supplementary voltage supply system can also be used as  
15 a starting time for the time-counter.

It is also preferred that the arrangement comprises an analogue-to-digital converter, which determines the analogue values in relation to a reference voltage, the value of which is also used as starting point for determining coil current and coil supply voltage. A constant relationship between the reference voltage of the  
20 analogue-to-digital converter, the coil current and the coil supply voltage can consequently be achieved. In this way, high measuring accuracy is achieved, without unduly high demands being made in respect of stabilising of the reference voltage, the coil current or the coil supply voltage.

The invention is described in detail hereinafter with reference to preferred  
25 exemplary embodiments in conjunction with the drawings, in which:

- Fig. 1 shows a first embodiment of the invention,  
Fig. 2 shows a second embodiment with a supplementary coil supply voltage,  
Fig. 3 shows a waveform for the current through a current regulator,  
30 Fig. 4 shows the same waveform, but over a shorter time period, and

Fig. 5 shows a juxtaposition of two current flows.

Fig. 1 shows an electromagnetic flowmeter 1 having a measuring tube 2, the flow through which is perpendicular to the plane of the drawing. The measuring tube 2 is electrically insulated. Arranged perpendicular to the direction of flow is a coil arrangement consisting of two coils 3, 4, which generate a magnetic field perpendicular to the direction of through-flow when current flows through the coils 3, 4. Measuring electrodes 5, 6 and earth electrodes 7, 8 are provided in the measuring tube 2. The measuring electrodes 5, 6 are arranged so that they detect a potential difference or voltage perpendicular to the direction of through-flow and perpendicular to the magnetic field. The voltage between the electrodes 5, 6 rises in a manner known *per se* as the speed of the fluid in the measuring tube 2 increases and as the magnetic field increases.

The coils 3, 4 are connected in series and are supplied from a supply source 9 with a voltage  $V_{nom}$ , the direction of the coil current being determined by an H-bridge circuit with four switches 10-13, each switch being protected by a free-wheeling diode 14-17. When the current is intended to flow anti-clockwise (as seen in Fig. 1) through the coil arrangement 3, 4, the switches 10, 13 are closed. The switches 11, 12 remain open. When the current direction is to be reversed, the switches 11, 12 are closed and the switches 10 and 13 are opened.

The coil current is regulated by a current regulator 18, which is to ensure that the current through the coil arrangement is constant. The current  $I$  through the coil arrangement 3, 4 is then passed through a measuring resistor 19. The measured voltage across the measuring resistor is supplied to a comparator 20, the other input of which is supplied with a constant voltage that is obtained from a voltage divider comprising three resistors 21, 22, 23 with a reference voltage  $V_{ref}$  at their input 24. The output of the comparator 20 is connected to a timer 25. The timer 25 is additionally connected to a control circuit, not specifically shown, which controls the operation of the switches 10-13.

For the rest, the measuring electrodes 5, 6 are connected to a differential amplifier 27, the output of which is connected to an analogue-to-digital converter 28. The analogue-to-digital converter 28 is supplied from the same reference voltage source 24 as the voltage divider 21-23. At its output 29 it produces digital values for the through-flow determined.

When the switches 10-13 are operated, that is, the direction of the current  $I$  through the coil arrangement 3, 4 is reversed, the time-counter 25 starts to count or measure the time. This time counting is continued until the voltage across the measuring resistor 19 is the same as the voltage across the resistors 22, 23. At that time, the comparator 20 sends a signal to the time counter 25, which stops counting and gives out the determined time at its output 26.

The time at the output is compared with a time determined earlier, for example, during initial operation of the flowmeter. In uninterrupted operation the currently determined time should be the same as the time determined earlier and at any rate should have quite small variations within a tolerance range. If this is not the case, it points to a change in the flowmeter that could signify an error in the measuring result.

To compensate for temperature fluctuation, a further resistor (not shown) having a negative temperature coefficient can be arranged in series with the coils 3, 4. The electrical resistance of the current path from the voltage source 9 to the measuring resistor 19 therefore remains substantially the same, regardless of the temperature, so that no changes are caused thereby.

Fig. 2 shows a modified embodiment. The coil arrangement 30 is connected to the H-bridge 32, now represented merely diagrammatically, which is connected between the voltage source 31, which supplies a normal voltage  $V_{nom}$ , and the measuring resistor 35, which in turn is connected to earth. The resistors 38-40 correspond to the resistors 21-23. The comparator 36 corresponds to the comparator 20 and the timer 46 corresponds to the timer 25.

As a modification to the construction according to Fig. 1, a supplementary voltage supply 44 has now been added, which supplies a supplementary voltage

Vboost. This supplementary voltage supply 44 is applied via a change-over switch 33 to the H-bridge 32, specifically, from a time at which the current direction is reversed to a time when the current has reached a predetermined value again. The supplementary voltage Vboost is higher than the normal voltage Vnom, so that the  
5 rise in the current is effected more quickly.

The current regulator 34 is, as in the construction according to Fig. 1 also, regulated by a reference voltage across the resistor 40 of the voltage divider 37. This voltage serves as reference.

In addition, the voltage across the resistor 40 is supplied to a further  
10 operational amplifier 43, the output of which is connected to the supplementary voltage supply system 44. The other input of the operational amplifier 43 is connected to the centre tap of a voltage divider comprising two resistors 41, 42, which is arranged between the output 45 of the supplementary voltage supply system 44 and earth. The output of the operational amplifier 43 therefore regulates  
15 the supplementary voltage supply system 44, which can also be referred to as the "boost generator".

The output of the comparator 36 not only triggers the time-counter 46, but also the switch 33, so that in the time after change-over not only is the length of time necessary for the current to reach its predetermined value determined, but also in  
20 this time an increased voltage is used. This increased voltage moreover has the advantage that it is relatively accurate. Indeed, all voltages are related to the reference voltage Vref.

The time counter 46 determines, as stated, the length of time that is needed for the rise in the coil current after polarity reversal. This time is a measure of the  
25 electrical and magnetic properties of the system as a whole. This length of time is unique to a specific system, a kind of "fingerprint".

Because the same reference voltage Vref is used as the basis for regulating the coil current and the supplementary voltage supply system 44, a fixed and precise relationship between the supplementary voltage and the coil current can be  
30 reached. When this reference voltage is used at the same time to control the

analogue-to-digital converter 28 (Fig. 1), then very accurate measurements can be achieved. The measuring accuracy of the flowmeter is improved and at the same time the electrical and magnetic circuits of the flowmeter can be monitored.

Fig. 3 shows the waveform of the current  $I$  through the measuring resistor 19 in Fig. 1. On polarity reversal of the current direction, the coils 2, 3 will first of all try to keep the current at its previous intensity. Because of the free-wheeling diodes 14-17, the current through the measuring resistor 19 will briefly change its sign, the coil current dropping and changing direction.

Fig. 4 shows the same curve 47 to an enlarged scale, that is, for a shorter period. Since the rise in the coil current follows a specific physical natural law, the time period  $T$  is a measure that provides information about the rise in the coil current with sufficient reliability and certainty. This time period  $T$  should be the same at each change-over, or should vary only by a small differential amount from a set value.

Of course, it is possible also to take several measurements and to plot the curve 47 point by point, which is advantageously done by a microprocessor, not shown specifically. It is therefore possible to determine not only the parameter  $T$ , but in fact to compare a curve shape.

In Fig. 5, two curves are shown, of which the curve 47 is produced when the flowmeter is free from defects. In the curve 48, the rise is too rapid, that is, the time  $TF$  is too short. The curve 47 has been included again with its rise time  $T$  to make the differences clear.

The invention can also be carried out with several stabilised voltages, but in that case they may differ from one another only by relatively small amounts (a few microvolts).



Claims

1. A method for testing an electromagnetic flowmeter having a measuring tube and a coil arrangement for generating a magnetic field perpendicular to the direction of flow through the measuring tube, the current direction in the coil arrangement being periodically changed, characterized in that after the change in the current direction at least one parameter of the current rise is determined and this is compared with a reference value.
2. A method according to claim 1, characterized in that testing is carried out during measurement of a throughflow.
3. A method according to claim 1 or 2, characterized in that the reference value is determined on the flowmeter itself at an earlier time.
4. A method according to any one of claims 1 to 3, characterized in that a time period that elapses between two predetermined current values is used as parameter.
5. A method according to any one of claims 1 to 4, characterized in that a time period that elapses between change-over of the current direction and reaching a predetermined current value is used as parameter.
6. A method according to any one of claims 1 to 5, characterized in that after change-over, a stepped-up voltage is used.

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7. A method according to any one of claims 1 to 6, characterized in that the supply voltage of the coil arrangement is regulated ratiometrically in relation to a reference voltage which is also used to determine the parameter.
8. A method according to any one of claims 1 to 7, characterized in that the curve shape of the current rise is used as parameter.
9. A method according to claim 8, characterized in that the curve shape is formed by current values ascertained at predetermined times.
10. A method according to any one of claims 1 to 9, characterized in that current rises following directly one after the other are compared with one another.
11. An electromagnetic flowmeter arrangement having a measuring tube, a coil arrangement for generating a magnetic field substantially perpendicular to the direction of flow through the measuring tube, an electrode arrangement substantially perpendicular to the direction of flow and to the magnetic field, a supply system for the coil arrangement, which has a current direction change-over arrangement, and a testing device, characterized in that the testing device comprises means (25, 46) which, after a change-over of the current direction, determine at least one parameter (T) of the rise in the current in the coil arrangement (3, 4, 30) and compare it with a given value.
12. An arrangement according to claim 11, characterized in that the testing device comprises a time-counter (25, 46) and a rise time (T) serves as parameter.
13. An arrangement according to claim 12, characterized in that the testing device comprises a comparator (20, 36), which compares the current or a variable derived therefrom with a given value and which is connected to the time-counter (25, 46).

14. An arrangement according to claim 12 or 13, characterized in that the time-counter (25, 46) is connected to a checking unit which produces an error message whenever the time (T) ascertained differs by more than a predetermined difference from a given value.

15. An arrangement according to any one of claims 11 to 14, characterized in that in series with the coil arrangement (3, 4; 30) there is arranged an electrical resistance, the temperature-dependent resistance behaviour of which is inversely proportional to that of the coil arrangement (3, 4; 30).

16. An arrangement according to any one of claims 11 to 15, characterized in that a supplementary voltage supply system (44) is provided, which is connected to the supply system (32) by way of a change-over switch (33).

17. An arrangement according to any one of claims 11 to 16, characterized in that it comprises an analogue-to-digital converter (28), which determines the analogue values in relation to a reference voltage ( $V_{ref}$ ), the value of which is also used as starting point for determining coil current and coil supply voltage.

Abstract of the Disclosure

A method for testing an electromagnetic flowmeter and a flowmeter are described, the flowmeter having a measuring tube (2) and a coil arrangement (3, 4) for generating a magnetic field perpendicular to the direction of flow through the measuring tube (2), the current direction in the coil arrangement being periodically changed. In this connection, it is desirable for simple monitoring to be possible. For that purpose, after changing the current direction, at least one parameter of the current rise is determined and this is compared with a reference value. For this, the flowmeter has a testing device (20, 25) which, after a change-over of the current direction, determines at least one parameter (T) of the rise in the current in the coil arrangement (3, 4, 30) and compares it with a given value.

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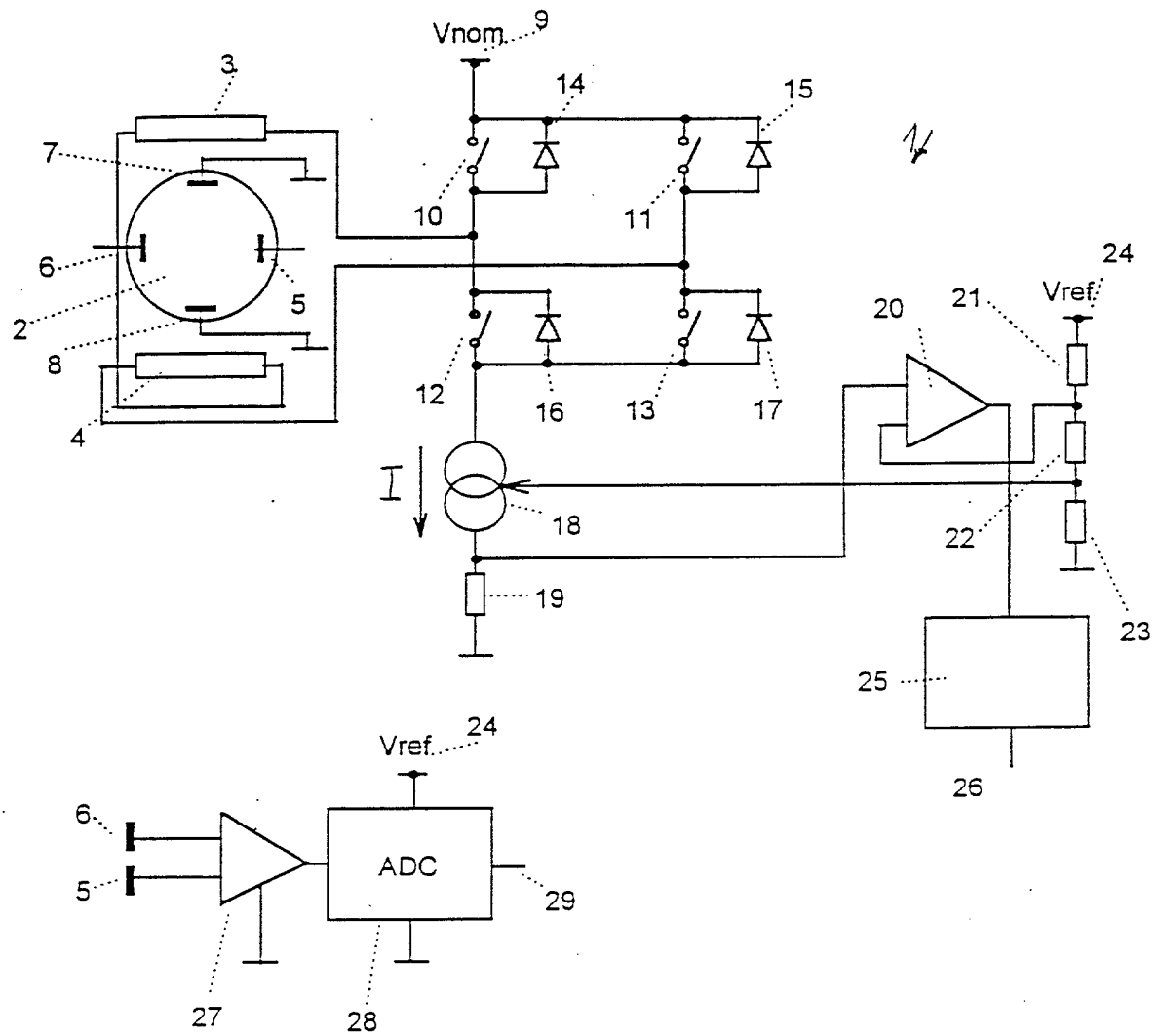


Fig.1

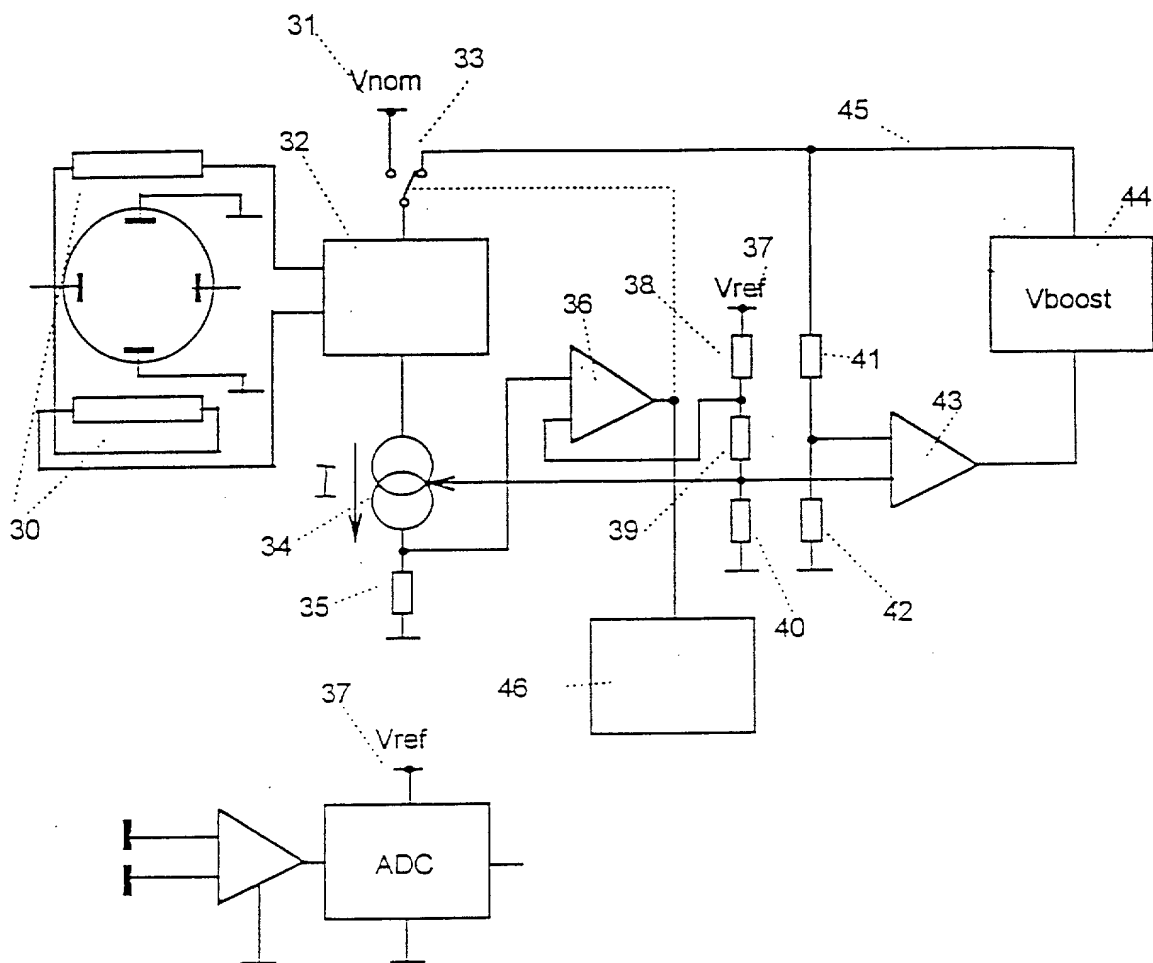


Fig. 2

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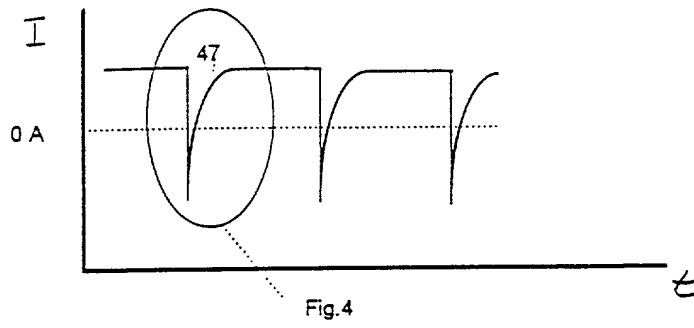


Fig.4

Fig.3

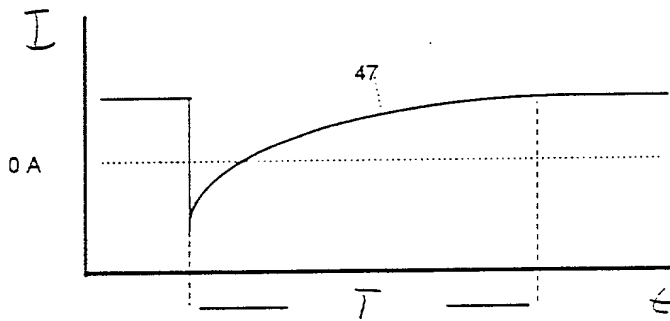


Fig.4

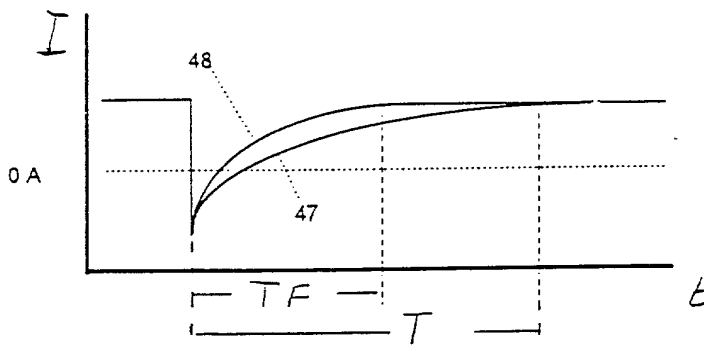


Fig 5

Attorney Docket No.

DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled METHOD FOR TESTING AN ELECTROMAGNETIC FLOWMETER, AND AN ELECTROMAGNETIC FLOWMETER ARRANGEMENT, the specification of which:

  X   is attached hereto.

       was filed on                      as

Application Serial No.                     

and was amended on                      (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, Section 1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119 of any foreign application(s) for patent or inventor's certificate listed below and have

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also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

**PRIOR FOREIGN APPLICATION(S)**

<u>Country</u>	<u>Number</u>	<u>Date Filed</u>	<u>Priority Claimed</u>	
			<u>Yes</u>	<u>No</u>
Germany (DE)	199 17 268.4	April 16, 1999	X	_____
_____	_____	_____	_____	_____

I hereby claim the benefit under Title 35, United States Code Section 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, Section 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, Section 1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application.

<u>Application Serial No.</u>	<u>Filing Date</u>	<u>Status</u>
_____	_____	_____
_____	_____	_____

And I hereby appoint Wm. Marshall Lee, Registration No. 16,853, John M. Mann, Registration No. 17,775, Thomas E. Smith, Registration No. 18,243, Dennis M. McWilliams, Registration No. 25,195, James R. Sweeney, Registration No. 18,721, William M. Lee, Jr., Registration No. 26,935, Glenn W. Ohlson, Registration No. 28,455, David C. Brezina, Registration No. 34,128, Jeffrey R. Gray, Registration No. 33,391, Timothy J. Engling, Registration No. 39,970, Gregory B. Beggs, Registration No. 19,286, Gerald S. Geren,

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Registration No. 24,528 and Peter J. Shakula, Registration No. 40,808 as my attorneys to prosecute this application and to transact all business in the Patent and Trademark Office connected herewith. It is requested that all communications be directed to Lee, Mann, Smith, McWilliams, Sweeney & Ohlson, P.O. Box 2786, Chicago, Illinois 60690-2786, telephone number (312) 368-1300.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full name of sole inventor:

Matzen, Steen M.

Signature

Steen Matzen

Date 2000.03.01

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